

IN THE INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY (IPEA/US)
PATENT COOPERATION TREATY

Appl. No. : PCT/US03/29946
Applicant : William Marsh Rice University
Filed : 23 September 2002
TC/A.U. :
Examiner : Gregory J Toatley
Docket No. : 1789-11501
Title : Non-Destructive Optical Imaging System
for Enhanced Lateral Resolution

RESPONSE TO WRITTEN OPINION DATED 7 JANUARY 2005
AND ARTICLE 34(2)(b) AMENDMENT

Atty. Dkt. No.: 1789-11501
Date: March 7, 2005

Mail Stop PCT, Attn: IPEA/US
Commissioner for Patents
P. O. Box 1450
Alexandria, VA 22313-1450

Sir:

In response to the Written Opinion dated 7 January 2005, please enter the following
Remarks. The claims are not currently amended.

REMARKS

Applicant acknowledges receipt of the Written Opinion of 7 January 2004, in which the Examiner rejected all pending claims as being anticipated by and obvious in view of Deck (U.S. Patent 6,028,670). Applicants respectfully submit that the Deck reference does not in fact teach the concepts claimed in the present case and that the claims as written are distinguishable over the art. Applicants' reasons are as follows.

The '670 patent describes a method for improving the ability of an interferometer to distinguish between objects whose height difference is greater than $\frac{1}{4}$ of the optical wavelength. The '670 patent teaches the use of both monochromatic light and white light sources to improve resolution in the vertical dimension. Because the white light includes energy having a spectrum of wavelengths, the method disclosed in the '670 patent allows the instrument to observe surfaces with larger topographic variation at higher vertical precision than is possible with monochromatic light alone.

In the '670 reference, the vertical scanning via a spectrum of wavelengths (white light) is used to eliminate the ambiguity in height of the target surface that occurs when the surface has vertical variations larger than the wavelength of light source. For monochromatic light, this ambiguity becomes a problem when the topography of the surface varies by more than 400-700 nm. With the vertical scanning and the use of white light, a much larger range of topography can be observed at high vertical precision.

Notably, Figure 3 in the '670 patent shows the offset between multiple images by translation on the X axis of the graph. The X axis, labeled "Scan Position," relates to the wavelength and thus is actually an indication of a vertical offset in the interferometer. Thus, the Figures of the '670 patent, and in particular Figure 3A and 3B, all illustrate the ability of the '670 method to detect variations in the height of features on the surface of interest.

By contrast, the present application describes a method of acquiring a set of images with controlled small horizontal (lateral) shifts of the field of view of an interferometer or the target, and the combination of those images to increase the lateral resolution of the resulting image. While on the surface, the vertical shifts referred to in Patent '670 sound similar to the horizontal shifts referred to in our application, they are different. They are employed for different purposes, and one could not be substituted for the other. One is a *shift in light wavelength* and the other is a *shift in the relative physical positions* of the target object and optical device.

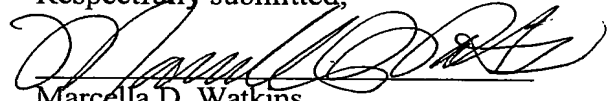
Lastly, the factors which control/limit horizontal resolution in an interferometer are different from those that control/limit vertical precision. Horizontal resolution is limited by,

for example, the quality of the lenses, the degree of magnification of the system, the size of the physical pixel sensors in the digital imaging system (digital camera), and the wavelength of the light source. The method of the present invention can improve lateral resolution regardless of which of these factors is providing the limit on lateral resolution.

Although the Examiner states that the '670 patent anticipates claims 1, 11, 14, and 16, Applicants respectfully disagree, inasmuch as the '670 patent makes no teaching or suggestion, let alone disclosure, of a system in which an X-Y positioning system positions one or both of the target object and the optical device at multiple pre-determined locations with "movements smaller than the obtainable lateral resolution of the optical device." Thus the Examiner has not met the burden of proof with respect to anticipation. Because the independent claims are distinguishable over the art, the claims that depend from them are also allowable.

Applicants therefore respectfully submit that the claims as they presently stand are in condition for allowance. Applicants therefore request that the Examiner reconsider and withdraw the rejections. If the Examiner has any questions or comments, or otherwise feels it would be advantageous, he is encouraged to telephone the undersigned at (713) 238-8043.

Respectfully submitted,



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